

SECTION 3. PHYSICAL AND SOCIAL ENVIRONMENT

North Carolina's physical environment—its terrain, soils, and geology—have determined the nature of its river basins and aquifers and thereby the availability of water supplies. The availability of water for public water supply, industry, power generation, and navigation has been an important factor influencing the location and amount of growth in North Carolina.

In turn, North Carolina's economic and population growth has led to the construction of reservoirs and to increased use of surface and ground water, which has changed the “natural” availability of water.

The amount of water available for public water supply in North Carolina will continue to be influenced by the interplay between the natural availability of water in each part of the state and the impacts of our increasing use of our water resources.

3.1 Geography and Climate

Despite the rapid growth occurring in the state, most of North Carolina's 52,669 square miles remain undeveloped. Forestland accounts for about half (51 percent) of the total area. An additional 24 percent of the state is cropland or pastureland, and about 8 percent is covered by water. Developed land, at 10.5 percent, accounts for most of the remaining area, along with federal lands not in National Forests at 3.6 percent and other minor land uses at 3 percent. The proportion of developed land has been growing while the proportions of cropland and forestland have been declining. From 1982 to 1999, developed land area increased from 7.7 percent to 10.5 percent of total area, while forestland and cropland areas each decreased by more than 2 percent in total area.

Located between 34 and 37 degrees north of the equator, North Carolina generally has a humid subtropical climate characterized by short mild winters and humid summers. The predominance of warm season precipitation and annual average precipitation of 48 inches means there is usually an adequate amount of rainfall to support agriculture, supply water to our towns and cities, and maintain healthy streamflows.

Stretching over 500 miles inland from the Outer Banks, North Carolina's elevation begins at sea level in the east and rises to over 6,500 feet in the western mountains. The state can be divided into three distinct physiographic regions—Coastal Plain, Piedmont, and Mountains. These regions are shown in Figure 3-1.

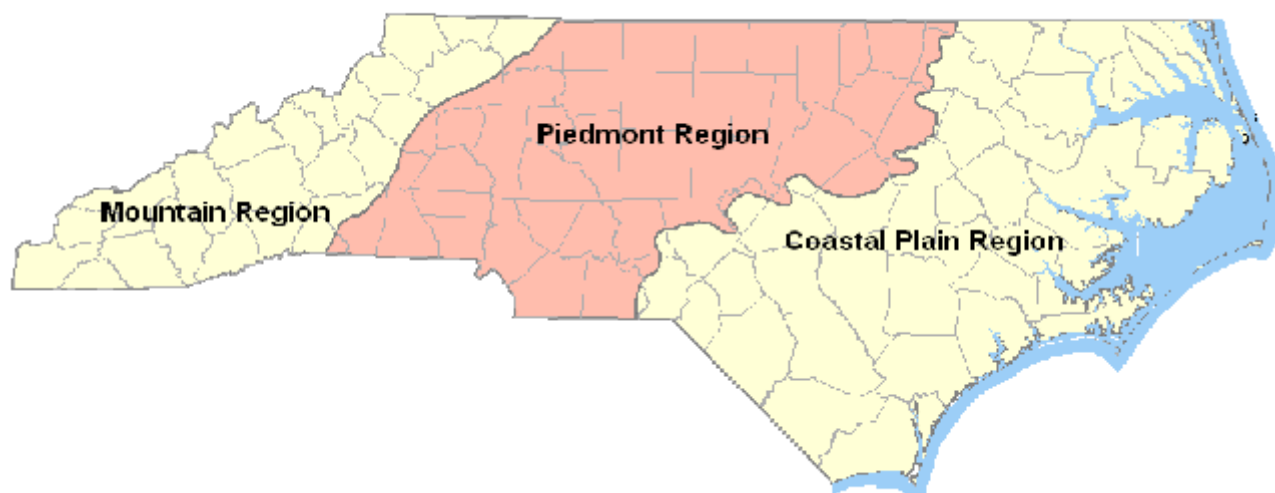


Figure 3-1. General Physiographic Regions of North Carolina

3.1.1 Coastal Plain

The Coastal Plain covers about 23,000 square miles of land along the Atlantic Coast characterized by flat terrain, swamplands, estuaries, and sandy beaches. Elevations in this region range from sea level along the coast to near 300 feet along its western boundary with the Piedmont. Vast areas of the Coastal Plain lie only a few feet above sea level. The Coastal Plain is composed of layers of sediments that have accumulated over millions of years from the weathering of the lands to the west. These layers of sediments form a series of productive aquifers that store vast quantities of water.

Annual precipitation ranges from 40-50 inches in the western Coastal Plain to 50-60 inches along the coast. The Coastal Plain is the main agricultural region of the state, with over 3.1 million acres of harvested cropland producing food and fiber crops for market. However, in recent years field crops have been surpassed by livestock operations as the major source of agricultural income.

The attractiveness of the North Carolina coast has led to rapid population growth in many coastal communities. This pattern is expected to continue as the popularity of the North Carolina coast continues to grow. While many rivers flow through the Coastal Plain, the flat terrain offers few natural locations to develop reservoirs to hold water. Use of coastal rivers for water supply is also limited by the movement of salt water upriver during dry periods. Most residents of the region depend on ground water from the underlying regional aquifer systems that have historically provided readily-accessible water.

3.1.2 Piedmont

The gently rolling terrain of the Piedmont covers about 17,500 square miles, or a little over a third of the state. Elevation in the Piedmont generally rises from about 300 feet above sea level near the fall line, where it meets the Coastal Plain, to around 1500 feet where it merges with the mountains. Precipitation averages from 40 to 50 inches per year over most of the region. The rolling hills in the Piedmont provided locations to economically develop dams and harness the power of the rivers flowing through the region. There are many privately controlled reservoirs built for hydropower generation as well as community water supply reservoirs on the rivers of the region.

The Piedmont is the manufacturing region of the state. This region is also the most populous region in the state with about 56 percent of its population classified as urban. Much of the state's population growth is taking place in the Piedmont Urban Crescent, along the Interstate 40 and Interstate 85 corridors stretching from east of Raleigh westward to Charlotte. Dynamic growth in the state's largest metropolitan areas of Charlotte, the Piedmont Triad, and the Research Triangle is driving suburban sprawl that is shrinking the amount of rural land that has historically separated the state's urban centers.

3.1.3 Mountains

The Mountain region covers about 9000 square miles. The Eastern Continental Divide runs through this region along the ridges of the Blue Ridge Mountains. This series of ridge lines forms the divide between the Atlantic and Mississippi drainages. Waterways on the western slope drain to the Tennessee and Ohio River basins and eventually flow into the Gulf of Mexico. Many rivers in the Tennessee River drainage are regulated by the Tennessee Valley Authority dams for flood control, hydroelectric power, and navigation purposes. Runoff from the eastern side of the divide flows to the Atlantic Ocean by way of rivers flowing through Georgia, South Carolina, and North Carolina.

The mountains create a barrier to moist air moving easterly from the Gulf of Mexico. As moist air masses rise over the mountains, much of the moisture falls on the western slopes, reducing the amount of moisture available to fall on the eastern slopes. The extremes of annual precipitation in the state can be found in this region. The area around Macon County, west of the divide, receives the highest annual average precipitation of over 90 inches, while the Asheville area, lying in the rain shadow, has the lowest annual average of about 38 inches.

The steep hillsides of the Appalachian Mountains and shallow soils that dominate this region are heavily forested, with much of the land contained in the Pisgah and Nantahala National Forests. The valley bottoms and the areas of gently sloping terrain support agricultural operations and are the locations of most of the developed lands in the region. Forest products, including Christmas tree production, are major components of the regional economy. This region is the least populated in the state and continues to maintain a rural population distribution. However, some of the counties in this

region are experiencing increasing growth rates as the region has become more accessible because of highway improvements. In addition, the Mountains have become a popular retirement and second home location.

3.2 Economy and Growth

North Carolina is in a period of economic growth and transition, accompanied by rapid population growth. The state also continues to make major investments in industrial recruitment, its university and technical college systems, and infrastructure such as roads, water, and sewer to support this growth. During the last thirty years, North Carolina has changed from a predominantly agriculturally-oriented economy to a more manufacturing-intensive state. The mix of manufacturing sectors continues to change as well. The historically dominant sectors of textiles, tobacco, and furniture are being challenged by expansions in the transportation, health, and electronics sectors. The non-manufacturing sectors of the economy, especially services, are also expected to continue expanding. Since water use varies among sectors of the economy, the economic transition taking place will change how and where water is used.

Growth in urban areas of North Carolina during the 1980s pushed the state from its historical status as a rural state to one that is now predominantly urban and suburban. According to the Office of State Planning, the population of North Carolina has increased over 40 percent since 1970. The Office of State Planning estimated the July 1997 population at 7.55 million, a 13.8 percent increase over the 1990 census figures, making North Carolina the eleventh most populous state. By April 2000, the population had grown to 8.05 million, 21.4% more than 1990. The appeal of North Carolina as a relocation destination has been enhanced in recent years by low unemployment and high rankings in national surveys of desirable places to live and work. The state's population is projected to grow to 9.6 million by 2020.

Like water resources, population is not evenly distributed across the state. Growth in metropolitan areas and along the coast has outpaced growth in rural areas. A distinctive feature of this pattern is the expanding band of suburban and urban areas that stretches across the Piedmont from east of Raleigh westward through the Triad and southerly to Charlotte. Growth in many of the coastal counties is increasing at dramatic rates as well. From 1990 to 1999, population in Brunswick, Pender, Currituck, Dare, and New Hanover Counties all grew by over 23 percent. This is comparable to growth in some of the Piedmont's metropolitan counties. For instance, over the same period, Wake, Hoke, Johnston, and Union Counties grew by over 36 percent; Harnett, Franklin, Cabarrus, Iredell, and Mecklenburg Counties grew by over 24 percent; and, Moore, Yadkin, Chatham, Orange, Randolph, Davie, Granville and Lee Counties all grew by over 17 percent. Not all counties experienced such dramatic growth. Eight counties had growth rates less than 3 percent, and eight

counties—Bertie, Edgecombe, Northampton, Halifax, Hertford, Jones, Onslow, and Washington decreased in population.

Higher than average population growth is also occurring in the Mountain counties of Macon, Clay, Henderson, and Polk, along the border with Georgia and South Carolina. As with the coast, much of this growth seems to be the result of increased access, tourism, and increasing popularity of the area as a place to retire.

From a water supply perspective, this shift in development patterns means that demand for water is becoming more concentrated and increasing around these rapidly growing metropolitan areas. Water resources in the vicinity of these regional growth centers are being called on to provide more and more water to support our growing economy. The ability of water purveyors to meet demand depends on both the regional availability of water and the ability to finance additional water supplies and construction of water and wastewater facilities. Growing demand for water in areas where regional supplies are limited may increase the need to move water between river basins, increasing the reliance on interbasin transfers to meet water demands. Currently at least 110 water systems rely on transferring water between basins.

Figure 3-2 shows how overall water use has increased and varied by water use type over the last three decades in North Carolina.

3.3 Water Use Patterns

Each community's overall water use pattern varies depending on its particular mix of water customer types—residential, commercial, industrial, and institutional. Variations in water use can occur for each type of use, but residential demands typically cause the most variation throughout the year.

Residential water demands are a combination of indoor and outdoor water uses. Outdoor water uses tend to be seasonal, with use increasing during the summer months and peaking sharply during dry periods. The amount of water used for outdoor purposes varies with the lifestyle choices and the affluence of residential water users. If the financial means allow, residential water users may use large amounts of water for landscape irrigation and swimming pools. The seasonal nature of these outdoor uses raises demand for water in the hot summer months when available supplies are most subject to limitations. Coastal communities are also subject to major increases in demand during the summer months which bring an influx of seasonal residents.

Our personal lifestyle choices and preferred community development styles can have significant effects on community water demand. From a water supply planning perspective, this means that the useful life of water supply and treatment facility investments will be influenced by the type of development patterns that are encouraged by local land use plans, or are allowed because there is no local development plan.

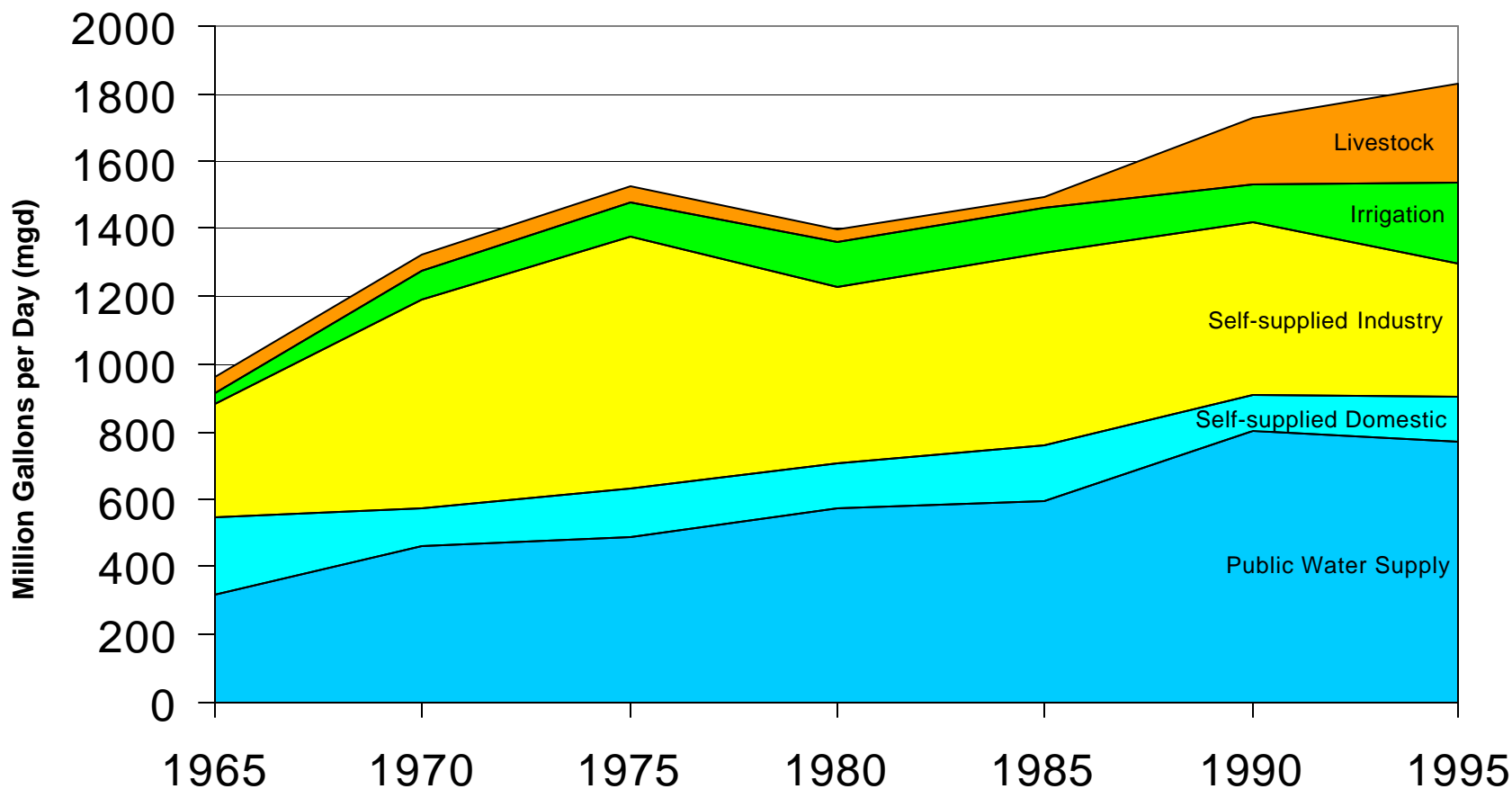


Figure 3-2. Water Use in North Carolina 1965 - 1995
 (data from USGS estimates of water use in North Carolina)